

Catharina Stroppel



Academic career

1991 - 1998	Diploma and school teacher degree Mathematics / Theology, Freiburg
1994 - 2000	Scientific Assistant, University of Freiburg
1998 - 2001	PhD in Mathematics (supervisor: Prof. W. Soergel), University of Freiburg
2000 - 2001	Teaching Assistant, University of Freiburg
2001 - 2003	Research Associate in Pure Mathematics, University of Leicester, England, UK
2003 - 2004	Associate Professor (CAALT Postdoc), University of Aarhus, Denmark
2004 - 2005	Research Associate, University of Glasgow, Scotland, UK
2005 - 2007	Lecturer, University of Glasgow, Scotland, UK
2007 - 2008	Reader, University of Glasgow, Scotland, UK
2007 - 2008	Von-Neumann Fellow, Institute of Advanced Study, Princeton, NJ, USA
2008 - 2010	Professor (W2), University of Bonn
Since 2010	Professor (W3), University of Bonn

Honours

1998	Ferdinand-von-Lindeman Prize for the best diploma thesis at the faculty, University of Freiburg
2007	Whitehead Prize, London Mathematical Society
2007	Von-Neumann Award, Institute of Advanced Study
2009	Professor Invité, Paris, France
2014 - 2015	"Hirzebruch Professor", Max Planck Institute for Mathematics, Bonn
2017	Teaching Award, University of Bonn

Offers

2007	University of Wisconsin-Madison, WI, USA
2009	University of Vienna, Austria
2010	University of Chicago, IL, USA
2013	University of Glasgow, Scotland, UK

Invited Lectures

2010	International Congress of Mathematicians, invited speaker, Hyderabad, India
2011	Lecture series on Lie superalgebras, Cargese, France
2012	Lecture series on Springer fibers, Northeastern University, Boston, MA, USA
2012	Lecture series on categorification, Luminy, France
2013	Lecture series on categorified invariants of manifolds, MPI, Bonn
2013	Summer school on Category O, Freiburg
2014	Lecture series on Khovanov algebras, Program Math. Structures and Computations, Lyon, France
2014	Lecture series on categorification, Program on Algebraic Lie Theory, Glasgow, Scotland, UK
2016	Lecture series on representation theory of Lie superalgebras and categorification, Workshop, Bonn
2016	Geometric Representation Theory and Beyond, Clay Research Workshop, Oxford, England, UK
2017	Springer Fibers and Fukaya categories, HIM, Bonn

Research Projects and Activities

DFG Collaborative Research Center SFB/TR 45 “Periods, moduli spaces and arithmetic of algebraic varieties”

Principal Investigator

Series of Oberwolfach Workshops on “Interactions between Algebraic Geometry and Non-commutative Algebra”,

Organizer, 2014, 2018

Bonn International Graduate School of Mathematics

Associate Director, since 2017

DFG Cluster of Excellence “Hausdorff Center for Mathematics”,

Principal Investigator

HIM-Junior-Trimester,

Organizer, 2017

Conference “Panorama of Mathematics” (Bonn),

Organizer, 2015

MSRI Program Geometric Representation Theory,

Organizer, 2014

MSRI Program Non-Commutative Geometry,

Organizer, 2013

HIM-Trimester,

Organizer, 2011

Research profile

My main area of expertise is in geometric and combinatorial aspects of representation theory in particular in connection with topology and category theory.

My current and recent research is centered around a better and, if possible, an explicit understanding of categories with geometric origin which play important roles in representation theory. One family of examples are Fukaya categories arising from Kleinian singularities or from Springer theory, but also from convolution algebras obtained from moduli spaces of representations of quivers and from quiver flag varieties. Besides an explicit description the focus is on axiomatic definitions and the comparison of structural properties of the resulting categories.

A second focus of my research is on braid group actions on derived categories, in particular for braid groups of affine or hyperbolic type outside type A and their relevance in topology. In particular we expect here a connection with knot invariants in orbifolds which then should have a nice categorification using categories arising naturally in Lie theory. This would generalize Khovanov homology in a nontrivial way. The underlying analogue of a Reshetikhin-Turaev theory is hereby one of the main goal.

Another current research interest is the representation theory of super groups (like the orthosymplectic families, but also the so-called strange families) and make them accessible to more classical representation theoretic techniques, in particular with the goal to provide a geometric

description of the involved categories of representations. These should also provide techniques which are also applicable to the representation theory of algebraic groups in positive characteristics.

Finally I am working on finite and affine Schur algebras and their generalizations, in particular I like to describe them using graded versions arising from Quiver Hecke algebras. Hereby general homological properties as well as decomposition numbers over fields of positive characteristics are important and of interest. The general results will be applied explicitly to the representation theory of the general linear p -adic groups and the local Langlands program as well as to the representation theory of the classical alternating groups over fields in positive characteristics. In both cases a good interplay between geometric and combinatorial tools will be used and hopefully further developed.

Editorships

- Springer Lecture Notes (2011 - 2014)
- Algebra and Representation Theory (since 2016)

Research Area C Fusion rings and categorification questions are of interest for mathematicians and physicists. In particular allows categorification the interpretation of inverted quantum numbers and formal power series in q as as Euler characteristics of infinite complexes of graded vector spaces. We used this to categorify parts of the Reshetikhin-Turaev-Viro invariants for 3-manifolds, [14], [12], [11]. Fusion rings arising from quantum groups at roots of unity were studied from an integrable systems point of view in [15], from an algebraic point of view in [10] and where used to study the famous Brauer centralizer algebras in [8], [1]. One of the first successful categorifications was the famous Khovanov homology of links. It categorifies the Jones polynomial and lifts to an invariant of cobordisms of tangles up to signs. We addressed these sign issues in two papers describing a slightly twisted version of Khovanov homology which is functorial, see [3], [4].

Research Area F* One of my research interests is the interaction of geometry with representation theory and combinatorics. I studied in particular categories of representations of Lie superalgebras [9], [2] with its connections to the geometry of perverse sheaves on Grassmannians [6], Springer fibers [5] and its connections to algebras arising in classical invariant theory [7].

Supervised theses

Master theses: 17, currently 2
Diplom theses: 7
PhD theses: 7, currently 3

Selected PhD students

Hoel Queffelec (2013): “Sur la catégorification des invariants quantiques sl_n : étude algébrique et diagrammatique”,
now Chargé de recherche CNRS, Institut Montpellierain Alexander Grothendieck, University of Montpellier, France

Antonio Sartori (2014): “Categorification of tensor powers of the vector representation of $U_q(\mathfrak{gl}(1|-1))$ ”,
now Research Assistant, University of Freiburg

Joanna Meinel (2016): “Affine nilTemperley-Lieb Algebras and Generalized Weyl Algebras”,
now Telecom Bonn, part-time research

Arik Wilbert (2017): “Two-row Springer fibres, foams and arc algebras of type D ”,
now Postdoc in Melbourne, Australia

Habilitations

Olaf Schnuerer (2017), now in Muenster

Selected publications

- [1] Henning Haahr Andersen, Catharina Stroppel, and Daniel Tubbenhauer. Semisimplicity of hecke and (walled) brauer algebras. *J. Aust. Math. Soc.*, 103(1):1–44, 2017.
- [2] Michael Ehrig and Catharina Stroppel. On the category of finite-dimensional representations of $\mathrm{OSp}(r|\mathrm{OSp}(r|2n))$: Part i. In *Representation theory—current trends and perspectives*, EMS Ser. Congr. Rep., pages 109–170. Eur. Math. Soc., Zürich, 2017.
- [3] Michael Ehrig, Catharina Stroppel, and Daniel Tubbenhauer. The blanchet-khovanov algebras. In *Categorification and higher representation theory*, volume 683 of *Contemp. Math.*, pages 183–226. Amer. Math. Soc., Providence, RI, 2017.
- [4] M. Ehrig, C. Stroppel, and D. Tubbenhauer. Generic gl_2 -foams, web and arc algebras. *ArXiv e-prints*, 2016.
- [5] Michael Ehrig and Catharina Stroppel. 2-row springer fibres and khovanov diagram algebras for type d. *Canad. J. Math.*, 68(6):1285–1333, 2016.
- [6] Michael Ehrig and Catharina Stroppel. Diagrammatic description for the categories of perverse sheaves on isotropic grassmannians. *Selecta Math. (N.S.)*, 22(3):1455–1536, 2016.
- [7] Michael Ehrig and Catharina Stroppel. Koszul gradings on brauer algebras. *Int. Math. Res. Not. IMRN*, (13):3970–4011, 2016.
- [8] H. Haahr Andersen, C. Stroppel, and D. Tubbenhauer. Cellular structures using \mathbf{U}_q -tilting modules. *to appear in Pacific Journal of Math*, 2015.
- [9] Antonio Sartori and Catharina Stroppel. Categorification of tensor product representations of \mathfrak{sl}_k and category \mathcal{O} . *J. Algebra*, 428:256–291, 2015.
- [10] Henning Haahr Andersen and Catharina Stroppel. Fusion rings for quantum groups. *Algebr. Represent. Theory*, 17(6):1869–1888, 2014.
- [11] Catharina Stroppel and Joshua Sussan. Categorified jones-wenzl projectors: a comparison. In *Perspectives in representation theory*, volume 610 of *Contemp. Math.*, pages 333–351. Amer. Math. Soc., Providence, RI, 2014.
- [12] Pramod N. Achar and Catharina Stroppel. Completions of grothendieck groups. *Bull. Lond. Math. Soc.*, 45(1):200–212, 2013.
- [13] Jonathan Brundan and Catharina Stroppel. Highest weight categories arising from khovanov’s diagram algebra iv: the general linear supergroup. *J. Eur. Math. Soc. (JEMS)*, 14(2):373–419, 2012.
- [14] Igor Frenkel, Catharina Stroppel, and Joshua Sussan. Categorifying fractional euler characteristics, jones-wenzl projectors and 3j-symbols. *Quantum Topol.*, 3(2):181–253, 2012.
- [15] Christian Korff and Catharina Stroppel. The $\widehat{\mathfrak{sl}(n)_k}$ -wznw fusion ring: a combinatorial construction and a realisation as quotient of quantum cohomology. *Adv. Math.*, 225(1):200–268, 2010.
- [16] Catharina Stroppel. Parabolic category \mathcal{O} , perverse sheaves on grassmannians, springer fibres and khovanov homology. *Compos. Math.*, 145(4):954–992, 2009.
- [17] Volodymyr Mazorchuk and Catharina Stroppel. Projective-injective modules, serre functors and symmetric algebras. *J. Reine Angew. Math.*, 616:131–165, 2008.
- [18] Igor Frenkel, Mikhail Khovanov, and Catharina Stroppel. A categorification of finite-dimensional irreducible representations of quantum \mathfrak{sl}_2 and their tensor products. *Selecta Math. (N.S.)*, 12(3-4):379–431, 2006.
- [19] Catharina Stroppel. Categorification of the temperley-lieb category, tangles, and cobordisms via projective functors. *Duke Math. J.*, 126(3):547–596, 2005.